

**REMARKS**

Claim 6 has been amended to correct a typographical error.

Claims 1, 3 and 5-9 are rejected, and claim 4 is objected to as being allowable if rewritten in independent form.

Review and reconsideration on the merits are requested.

Claims 1, 3, and 5-9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication No. 2005/0087746 to Kryliouk et al. (“Kryliouk”) in view of U.S. Patent No. 5,766,783 to Utsumi et al. (“Utsumi”). According to the Examiner, “Figure 1(b) of Kryliouk discloses a boron-phosphide-based (111) semiconductor layer (160) stacked in parallel in a line-symmetric manner with respect to the a-axis of a (111) Si substrate (105).”

Applicants respectfully respond as follows.

Kryliouk and the proposed combination of Kryliouk and Utsumi do not disclose, teach, or suggest all of the limitations of claim, 1, 5, 9 or claims dependent thereon, because neither reference discloses “stacked on and in parallel . . . in a line-symmetric manner with respect to the a-axis.” As discussed further below, claims 1, 5 and 9 require stacking with respect to the a-axis, which is possible for the presently claimed invention because it uses a hexagonal crystal of SiC that has an a-axis in the {0001} crystal plane. However, this is not possible in Kryliouk, because Kryliouk discloses cubic crystals of silicon and diamond, which have no a-axis.

Moreover, Kryliouk does not disclose the words “stacked in parallel in a line-symmetric manner with respect to the a-axis.” Figure 1(b) of Kryliouk shows a GaN LED in which a BP layer is stacked on a Si (111) substrate. See paragraphs [0036] and [0037] of Kryliouk. As described in Table 1 on page 2 of Kryliouk, the BP layer has a zincblende crystal structure, and the Si substrate has a diamond crystal structure. Both zincblende and diamond are cubic crystals.

Therefore, the BP layer having a cubic crystal is stacked on an Si (111) substrate having a cubic crystal in the LED shown in Figure 1(b) of Kryliouk.

The Si (111) substrate is formed of the (111) plane of the cubic crystal of Si, in which the a-axis is not present (see the attached, annotated reference information). Therefore, the BP layer cannot be stacked in parallel in a line-symmetric manner with respect to the a-axis of the Si (111) substrate as required by the present claims.

In contrast, the substrate of the presently claimed invention is formed of a hexagonal SiC crystal. As shown in FIG. 1 of the present specification, the a-axis is present in the {0001} crystal plane of the hexagonal crystal. Therefore, the {111} crystal forming the boron-phosphide-based semiconductor layer can be stacked on the silicon carbide substrate in a line-symmetric manner with respect to the a-axis of the {0001} crystal plane of the silicon carbide crystal substrate. In summary, Kryliouk does not disclose this characteristic feature of claims 1, 5 or 9 (“stacked on and in parallel . . . in a line-symmetric manner with respect to the a-axis”).

Moreover, Kryliouk does not disclose the advantages of the presently claimed invention, namely, that superior lattice matching can be attained between the silicon carbide crystal substrate and the boron-phosphide-based semiconductor layer, an excellent boron-phosphide-based semiconductor layer having few misfit dislocations can be produced, and excellent rectifying characteristics and breakdown voltage characteristics can be attained. See page 8, lines 4-10 of the specification.

Also, Utsumi does not disclose the aforementioned requirements of claims 1, 5 and 9, and does not disclose the advantages thereof. Therefore, Utsumi does not make up for the deficiencies of Kryliouk.

Thus, Applicants respectfully submit that claims 1, 5 and 9 would not have been obvious to a person skilled in the art. Moreover, the combination of Kryliouk and Utsumi does not teach, suggest or otherwise disclose each of the limitations of claims 1, 5 and 9. For this additional reason, it is respectfully submitted that the present claims are patentable over the cited prior art. In addition, dependent claims 3-4 and 6-8 should also be allowable.

Withdrawal of the rejection and allowance of claims 1 and 3-9 is earnestly solicited.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



---

Abraham J. Rosner  
Registration No. 33,276

SUGHRUE MION, PLLC  
Telephone: (202) 293-7060  
Facsimile: (202) 293-7860

WASHINGTON OFFICE

**23373**

CUSTOMER NUMBER

Date: December 17, 2008

# Miller index

## Reference Information

From Wikipedia, the free encyclopedia

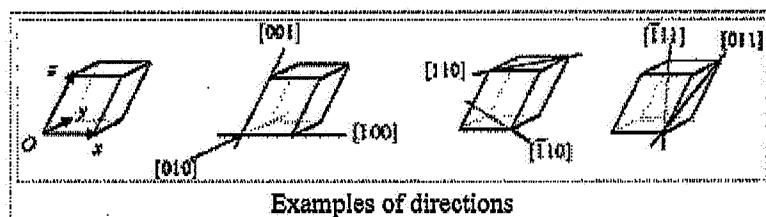
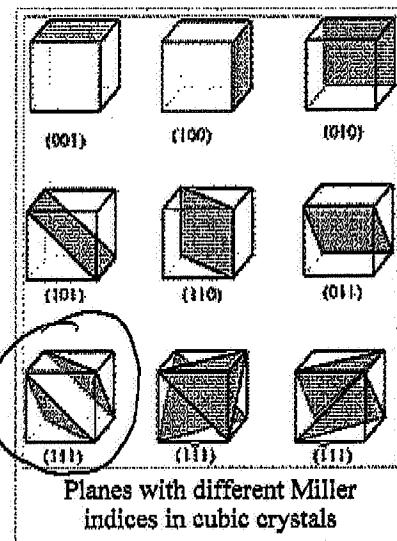
Miller indices are a notation system in crystallography for planes and directions in crystal (Bravais) lattices.

In particular, a family of lattice planes is determined by three integers  $\ell$ ,  $m$ , and  $n$ , the *Miller indices*. They are written  $(\ell m n)$  and denote planes orthogonal to a direction  $(\ell, m, n)$  in the basis of the reciprocal lattice vectors. By convention, negative integers are written with a bar, as in  $\bar{3}$  for  $-3$ . The integers are usually written in lowest terms, i.e. their greatest common divisor should be 1.

There are also several related notations.<sup>[1]</sup>  $[\ell m n]$ , with square instead of round brackets, denotes a direction in the basis of the direct lattice vectors instead of the reciprocal lattice. The notation  $\{\ell m n\}$  denotes all planes that are equivalent to  $(\ell m n)$  by the symmetry of the crystal. Similarly, the notation  $(\ell m n)\rangle$  denotes all directions that are equivalent to  $[\ell m n]$  by symmetry.

Miller indices were introduced in 1839 by the British mineralogist William Hallowes Miller. The method was also historically known as the Millerian system, and the indices as Millerian,<sup>[2]</sup> although this is now rare.

The precise meaning of this notation depends upon a choice of lattice vectors for the crystal, as described below. Usually, three primitive lattice vectors are used. However, for cubic crystal systems, the cubic lattice vectors are used even when they are not primitive (e.g., as in body-centered and face-centered crystals).



## Contents

- 1 Definition
- 2 Case of the cubic structures
- 3 Case of the hexagonal and rhombohedral structures
- 4 The crystallographic planes and directions
- 5 Integer vs. irrational Miller indices: Lattice planes and quasicrystals
- 6 See also
- 7 References
- 8 External links

## Definition

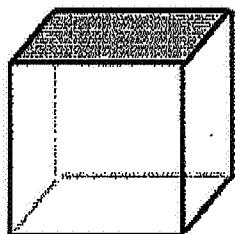
There are two equivalent ways to define the meaning of the Miller indices:<sup>[1]</sup> via a point in the reciprocal lattice, or as the inverse intercepts along the lattice vectors. Both definitions are given below. In either case, one needs to choose the three lattice vectors  $\mathbf{a}_1$ ,  $\mathbf{a}_2$ , and  $\mathbf{a}_3$  as described above. Given these, the three primitive reciprocal lattice vectors are also determined (denoted  $\mathbf{b}_1$ ,  $\mathbf{b}_2$ , and  $\mathbf{b}_3$ ).

Then, given the three Miller indices  $(\ell m n)$ , denotes planes orthogonal to:

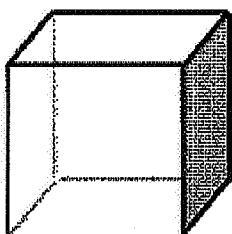
# Image:Indices miller plan exemple cube.png

From Wikipedia, the free encyclopedia

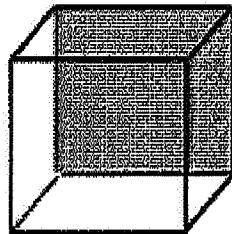
- [Image](#)
- [File history](#)
- [File links](#)



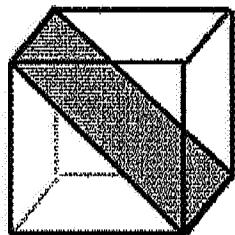
(001)



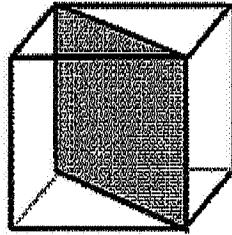
(100)



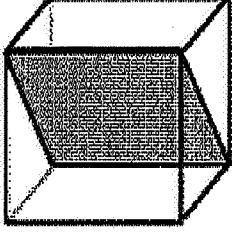
(010)



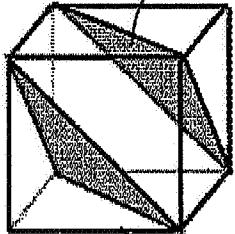
(101)



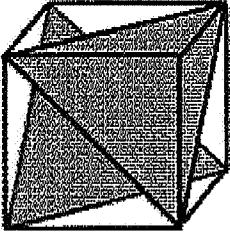
(110)



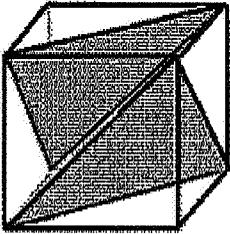
(011)



(111) -  $a$ -axis



(111)



(111)

Size of this preview: 498 × 599 pixels

Full resolution (1,037 × 1,247 pixels, file size: 25 KB, MIME type: image/png)

This is a file from the Wikimedia Commons. The description on its [description page](#) there is shown below.

Commons is a freely licensed media file repository. You can help.

## Summary

Exemple de plans cristallographiques et de leurs indices de Miller pour une structure cubique